Program
Sponsoring Work

DARPA – Bio:Info:Micro
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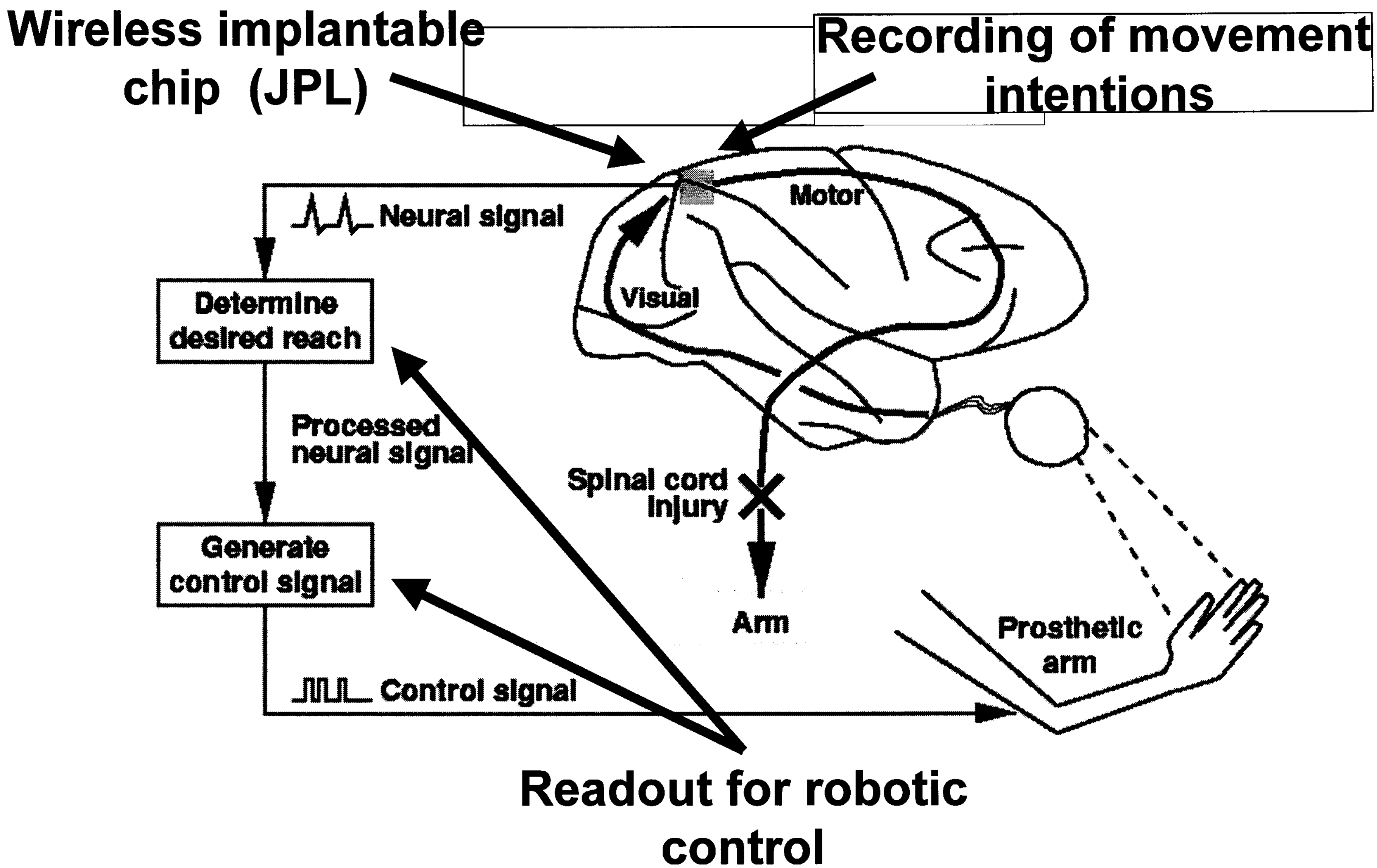
Using the posterior parietal cortex for a neural prosthesis



Unique features of our research

1) We use cognitive (planning) signals rather than motor (execution) signals. May be easier to generate plans and may require fewer neurons.

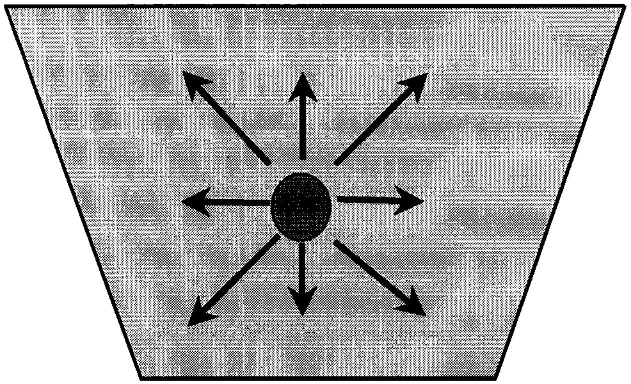
2) We record from visual-motor rather than somatic-motor areas.

  a) This may be an advantage for providing sensory feedback for prosthetic control.

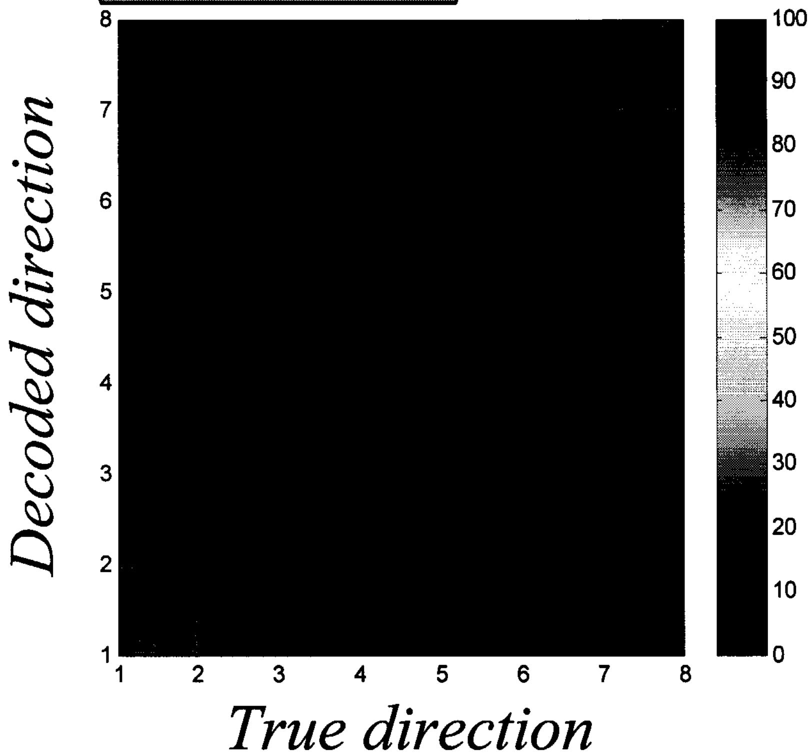
  b) The visual-motor areas of the posterior parietal cortex are very plastic.

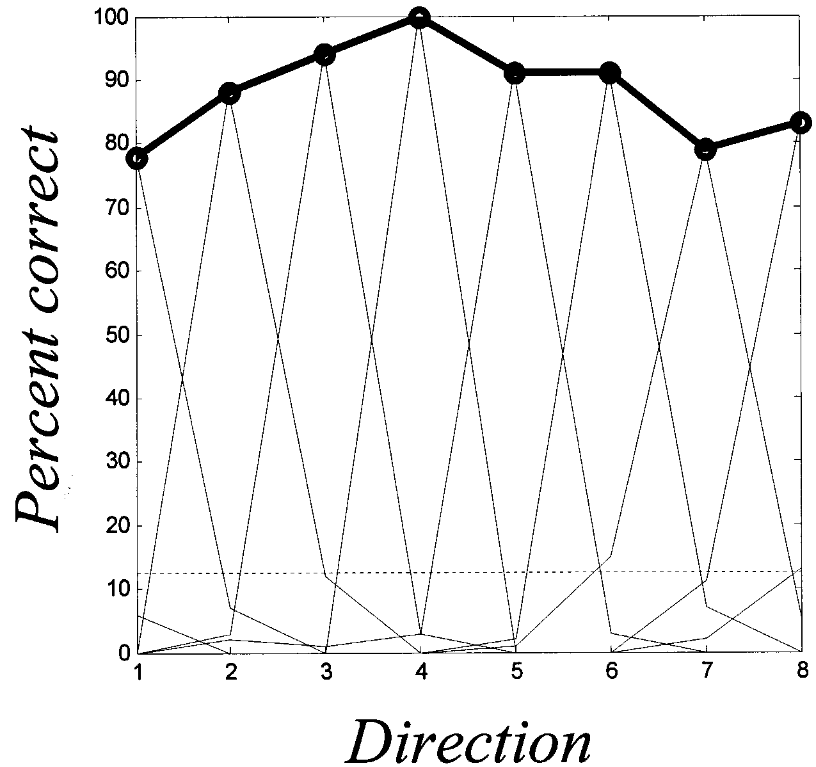
  c) The visual motor areas may show less degeneration with paralysis.

Decoding



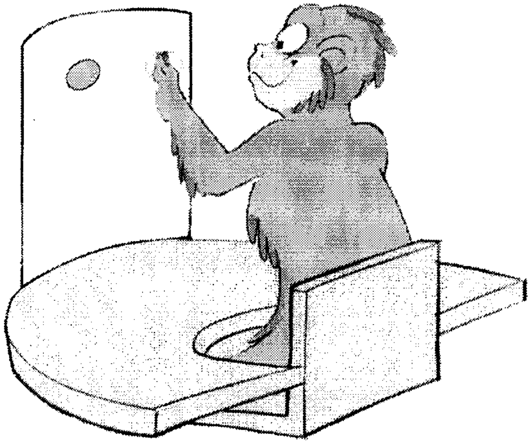
Decoding of 8 reach directions using 16 SPIKES



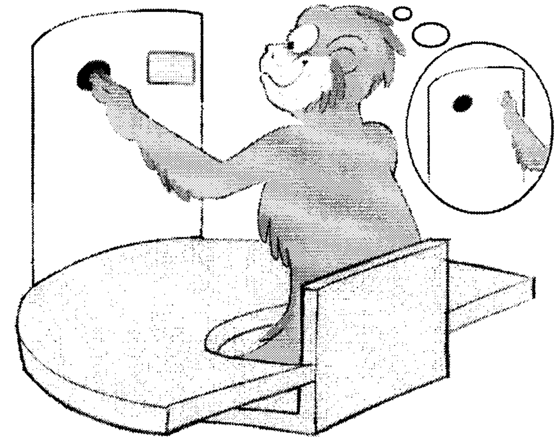


(n=16 recording sites)

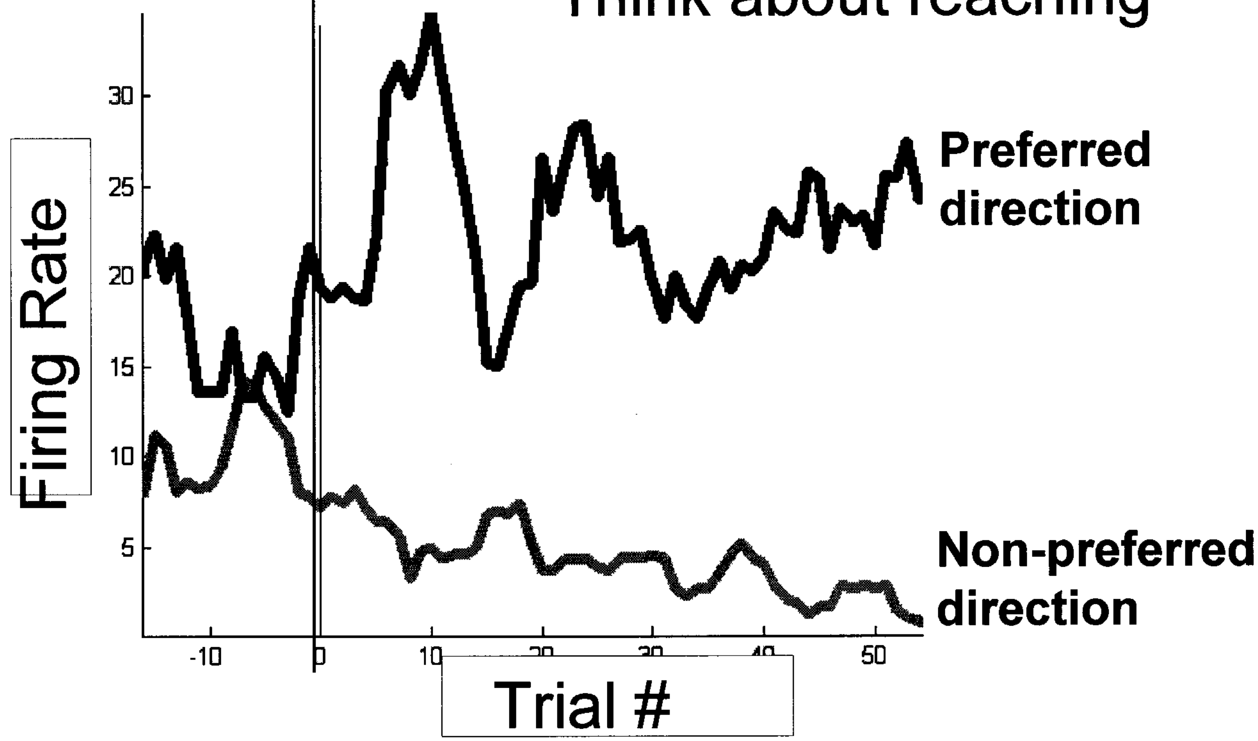
Rapid Plasticity, Single Cell



Reach



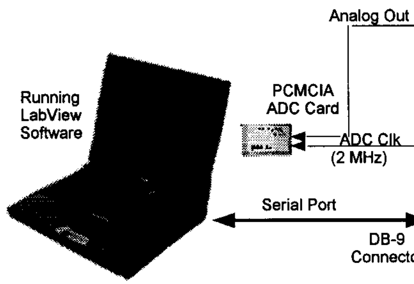
Think about reaching

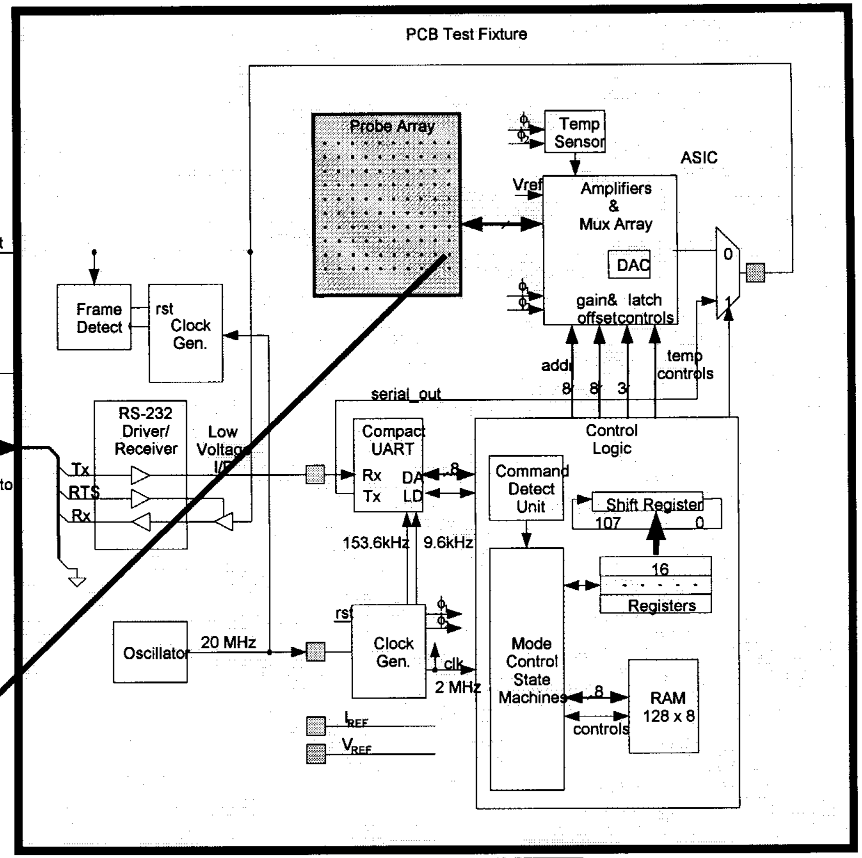


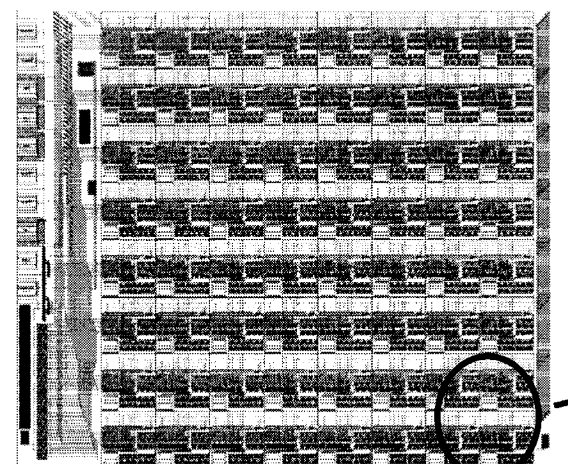
System Diagram and Requirements

Requirements :

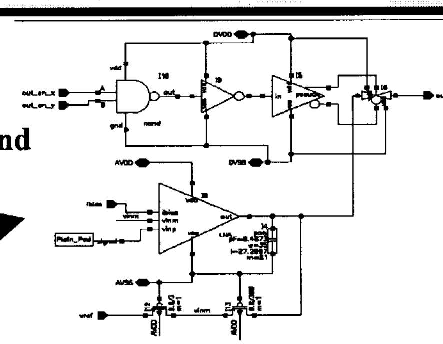
- Micro-power and low pin count
- Direct computer interface with 100% visibility to all working channels
- Amplifiers with programmable gain and offset using internal look-up table
- Programmable shut down of all unwanted channels
- On-the-fly calibration of amplifier gain and offset parameters
- Continuous scan of up to 100 analog probe channels @ 20 kHz using time-division multiplexing to be fed into a single ADC (> 2 MHz)
- On chip thermometry





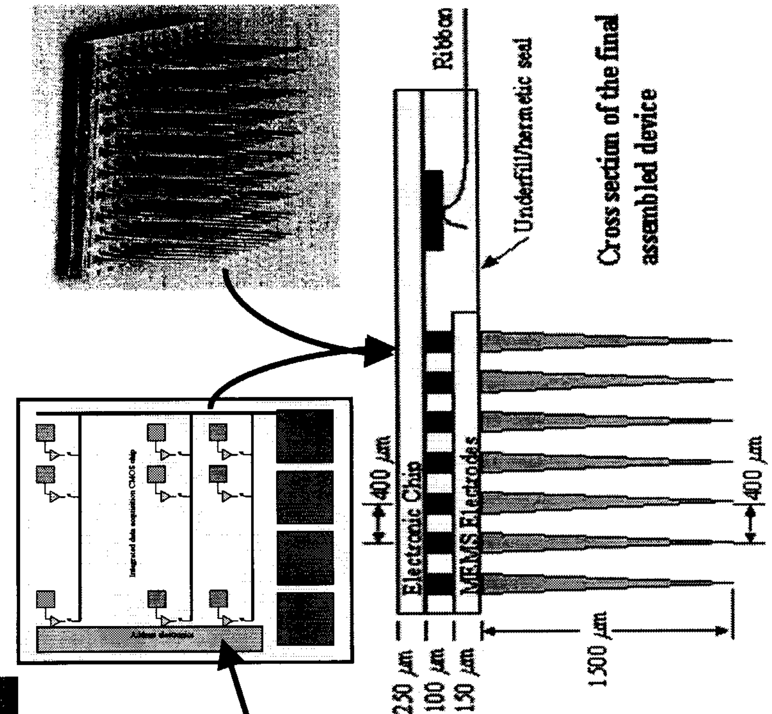


Micro Pad Array and Analog Amps

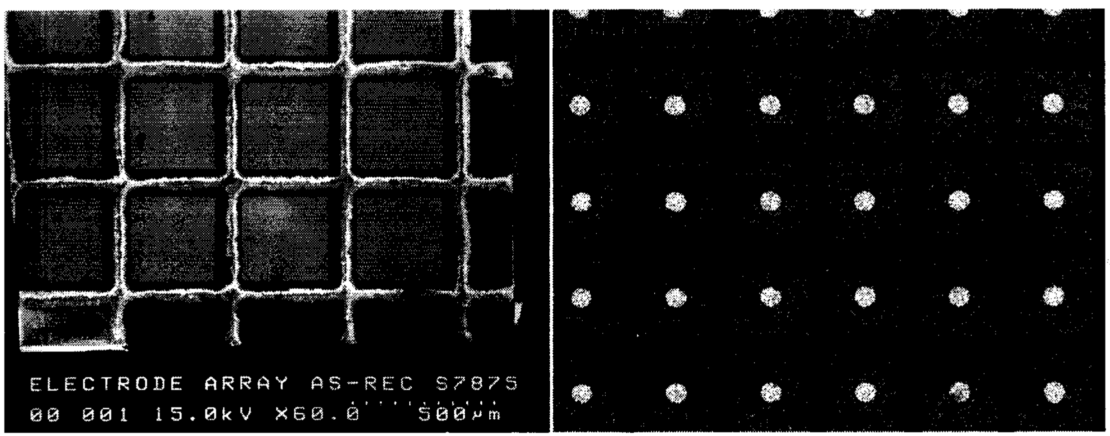


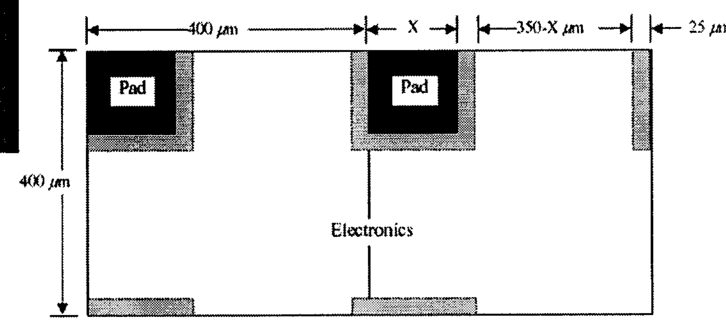
The First Phase, Utilize Electronics to Reduce I/O

- Each electrode terminates to its own pad and needs a wire
- 100 wires are needed for getting signals from all electrodes
- Goal is to heterogeneously integrate electrode array to electronic chip utilizing flip chip technology.
- For heterogeneous integration design a chip with a matrix of micro-pads with exact “foot print” as the pads in the MEMS array.
- To maximize area for electronics, pad size must be minimized.

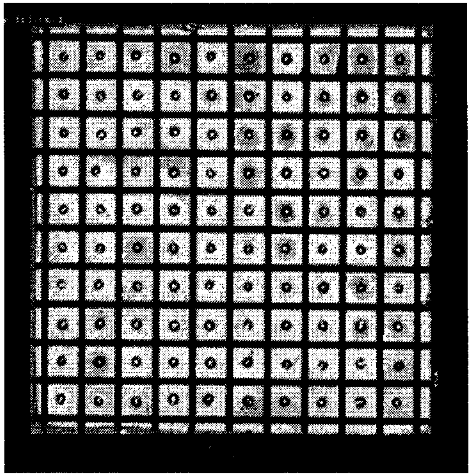


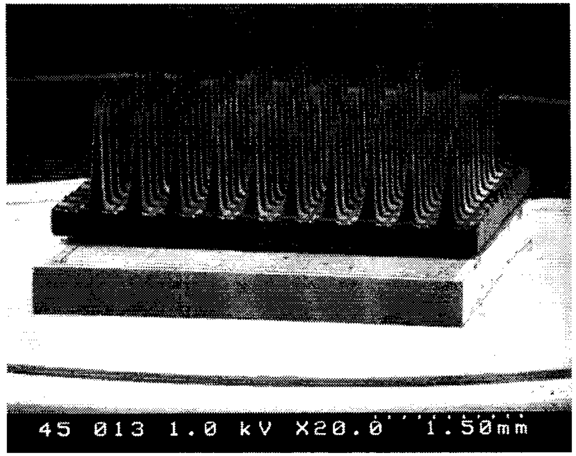
Data Acquisition Chip with multiplexing circuit reduces the number of wires to 8 and allows 100% “visibility” for all electrodes

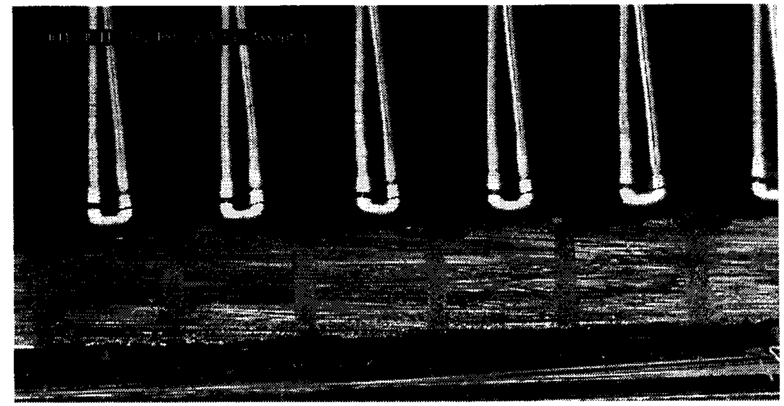




Assembly

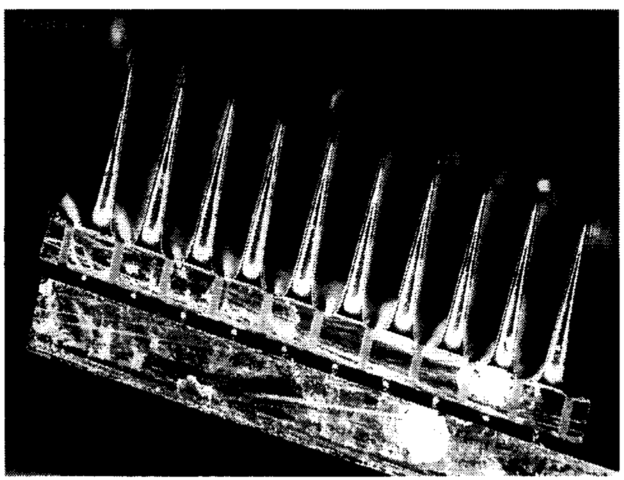


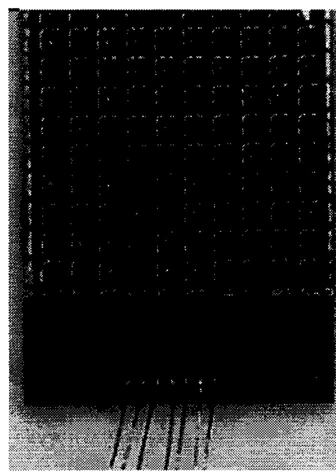




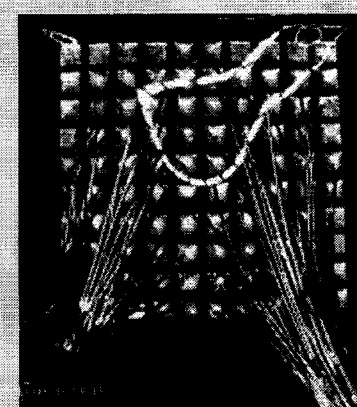
Solder bumped electrode array contact pads.

SEM of electrode array soldered to substrate.





Optical micrographs of electrode arrays soldered to substrates and wire bonds.



Passive electrode array without the electronics